

What is claimed is:

1. A variation detecting apparatus for detecting variations in ground objects in one and the same area between a line drawing map describing profile lines of said ground objects or an image obtained by picking up said ground objects from above (hereinafter referred to as "reference line drawing/image") and an image obtained by picking up said ground objects in the same area from above later on (hereinafter referred to as "target image"), comprising:

means for collating said reference line drawing/image with said target image so as to obtain variation indexes indicating whether there are variations or not in said ground objects respectively; and

means for displaying ground objects which can be judged to have variations or ground objects which cannot be judged as to whether there are variations or not on the basis of said variation indexes, in a display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other.

2. A variation detecting apparatus according to Claim 1, wherein:

said variation indexes are probabilities with which it can be concluded that there are variations, and probabilities with which it can be concluded that there is no variation; and

ground objects in which said probabilities with which it can be concluded that there are variations are not lower than a predetermined value are regarded as ground objects which can be judged to have variations, while ground objects in which said probabilities with which it can be concluded that there are variations are not higher than a predetermined value or ground objects in which said probabilities with which it can be concluded that there is no variation are not higher than a predetermined value are regarded as ground objects which cannot be judged as to whether there are variations or not.

3. A variation detecting apparatus according to Claim 1 or 2, wherein:

in said display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other, said areas are displayed in overlap with each other or placed adjacently to each other.

4. A variation detecting apparatus according to any one of Claims 1 through 3, further comprising:

means by which an operator referring to said area of said reference line drawing/image including said ground objects and said area of said target image including said ground objects displayed by said displaying means inputs a judgement result as to whether there are variations in said ground objects or not.

5. A variation detecting apparatus according to Claim 3, wherein:

when said area of said reference line drawing/image including said ground objects and said area of said target image including said ground objects are displayed in overlap with each other, said respective areas to be displayed are switched every period of predetermined time automatically or manually.

6. A variation detecting apparatus according to Claim 5, further comprising:

means for manually changing said switching display period.

7. A variation detecting apparatus according to Claim 3, wherein:

when said area of said reference line drawing/image including said ground objects and said area of said target image including said ground objects are displayed in overlap with

each other, the upper one of said respective areas is displayed in a predetermined transparent state so that the lower area can be seen through said upper area, and said areas are displayed while said transparent state is switched every a period of predetermined time automatically or manually.

8. A variation detecting apparatus according to Claim 7, further comprising:

means for manually setting said period with which said transparent state is changed automatically.

9. A variation detecting apparatus according to Claim 3, wherein:

when said area of said reference line drawing/image including said ground objects and said area of said target image including said ground objects are displayed in overlap with each other, an overlapped area is divided into a first area and a second area, and said area of said reference line drawing/image including said ground objects is displayed in said first area, while said area of said target image including said ground objects is displayed in said second area.

10. A variation detecting apparatus according to Claim 9, wherein:

said first and second areas are two areas divided by one

axis provided on said overlapped area or two areas divided by a biaxial rectangle provided on said overlapped area.

11. A variation detecting apparatus according to Claim 9, wherein:

said first and second areas are transformed automatically or manually.

12. A variation detecting apparatus according to Claim 11, further comprising:

means for manually changing a period of said transformation.

13. A variation detecting apparatus according to any one of Claims 1 through 12, wherein:

when there are a plurality of ground objects which can be judged to have variations or ground objects which cannot be judged as to whether there are variations or not, areas including said ground objects are displayed sequentially automatically or manually.

14. A variation detecting apparatus according to Claim 13, further comprising:

means for manually changing a display sequence changing display period when display is performed while the display sequence is changed every predetermined time automatically.

15. A variation detecting apparatus according to Claim 3, further comprising:

means for adjusting contrast of said area of said reference line drawing/image including said ground objects and contrast of said area of said target image including said ground objects so that a mean value of image pixel values is made to agree with a variance thereof in each of said areas when said areas are displayed in overlap with each other or placed adjacently to each other.

16. A variation detecting apparatus according to Claim 3, further comprising:

means for adjusting contrast of said area of said reference line drawing/image including said ground objects and contrast of said area of said target image including said ground objects so that brightnesses in two points specified in said areas are made to agree with each other while interpolation and extrapolation are carried out on any other point when said areas are displayed in overlap with each other or placed adjacently to each other.

17. A variation detecting method for detecting variations in ground objects in one and the same area between a line drawing map describing profile lines of said ground objects or an image

obtained by picking up said ground objects (hereinafter referred to as "reference line drawing/image") from above and an image obtained by picking up said ground objects in the same area from above later on (hereinafter referred to as "target image"), comprising the steps of:

collating said reference line drawing/image with said target image so as to obtain variation indexes indicating whether there are variations or not in said ground objects respectively; and

displaying ground objects which can be judged to have variations or ground objects which cannot be judged as to whether there are variations or not, in a display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other.

18. A variation detecting method according to Claim 17, wherein:

said variation indexes are probabilities with which it can be concluded that there are variations, and probabilities with which it can be concluded that there is no variation; and

ground objects in which said probabilities with which it can be concluded that there are variations are not lower

than a predetermined value are regarded as ground objects which can be judged to have variations, while ground objects in which said probabilities with which it can be concluded that there are variations are not higher than a predetermined value or ground objects in which said probabilities with which it can be concluded that there is no variation are not higher than a predetermined value are regarded as ground objects which cannot be judged as to whether there are variations or not.

19. A variation detecting method according to Claim 17 or 18, wherein:

in said display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other, said areas are displayed in overlap with each other or placed adjacently to each other.

20. A storage medium having a program stored therein and associated with a variation detecting method according to any one of Claims 17 through 19.

21. A variation detecting system comprising a variation detecting apparatus and a center apparatus, for detecting variations of ground objects between a reference line drawing/image composed of a line drawing/image describing



profile lines of said ground objects or an image obtained by picking up said ground objects from above and a target image obtained by picking up said ground objects in the same area from above later on, said center apparatus including:

a storage unit for storing said reference line drawing/image and said target image; and

means for providing one or both of said reference line drawing/image and said target image stored in said storage unit to said variation detecting apparatus issuing a request, through a communication line or a medium in response to said request issued by said variation detecting apparatus;

said variation detecting apparatus including:

means for collating said reference line drawing/image with said target image so as to obtain variation indexes indicating whether there are variations or not in said ground objects respectively; and

means for displaying ground objects which can be judged to have variations or ground objects which cannot be judged as to whether there are variations or not, in a display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other.

22. A variation detecting system comprising a variation detecting apparatus and a center apparatus, for detecting variations of ground objects between a reference line drawing/image composed of a line drawing/image describing profile lines of said ground objects or an image obtained by picking up said ground objects from above and a target image obtained by picking up said ground objects in the same area from above later on, said center apparatus including:

a first storage unit for storing said reference line drawing/image and said target image;

a second storage unit for storing a processing program for detecting variations of ground objects;

means for providing one or both of said reference line drawing/image and said target image stored in said first storage unit to said variation detecting apparatus issuing a request, through a communication line or a medium in response to said request issued by said variation detecting apparatus; and

means for providing said processing program stored in said second storage unit to said variation detecting apparatus issuing a request, through a communication line or a medium in response to said request issued by said variation detecting apparatus;

said variation detecting apparatus including:

means for collating said reference line drawing/image with said target image on the basis of said reference line drawing/image, said target image and said processing program provided by said center apparatus so as to obtain variation indexes indicating whether there are variations or not in said ground objects respectively; and

means for displaying ground objects which can be judged to have variations or ground objects which cannot be judged as to whether there are variations or not, in a display mode in which an area of said reference line drawing/image including said ground objects and an area of said target image including said ground objects can be compared with each other.

23. A variation detecting system according to Claim 21 or 22, said center apparatus further including:

means for accepting, through a communication line or a medium, a reference line drawing/image updated according to a variation detection result in said variation detecting apparatus, and storing said updated reference line drawing/image into a third storage unit.

24. A variation detecting system according to Claim 21, said center apparatus further including:

means for making accounting of a predetermined use fee whenever providing any one of said reference line drawing/image and said target image to said variation detecting apparatus issuing a request therefor.

25. A variation detecting system according to Claim 22, said center apparatus further including:

means for making accounting of a predetermined use fee whenever providing any one of said reference line drawing/image, said target image and said processing program to said variation detecting apparatus issuing a request therefor.

26. A variation detecting system according to Claim 23, said center apparatus further including:

means for paying an update fee corresponding to an updated reference line drawing/image to a manager of said variation detecting apparatus providing said reference line drawing/image whenever receiving said reference line drawing/image from said variation detecting apparatus.